

**Observations on the Nesting Behavior of
Belomicrus columbianus Kohl**

(Hymenoptera: Sphecidae)

STEVEN K. AULT¹

*Department of Parasitology, Liverpool School of Tropical Medicine,
Liverpool L3 5QA, England*

Observations on the nesting behavior of *Belomicrus columbianus* Kohl were made in late June and early July 1972. The study area was located on the east slope of Mount Rose, Washoe Country, Nevada at an altitude of approximately 8000 feet (2462 m.). This arid area consisted of dry sand and gravel, interspersed with rocks less than 3 cm diameter, and covered with sparse low vegetation.

Belomicrus Costa is a genus of gregarious fossorial wasps, with more than 50 species, thought to be an evolutionary intermediate between strictly solitary wasps and semi-social wasps and which today occurs in the Nearctic, Palaearctic, and Ethiopian regions (Evans and Eberhard, 1973). Very few published accounts of the biology of *Belomicrus* exist. Nesting behavior of *Belomicrus franciscus* Pate and *Belomicrus forbesii forbesii* (Robertson) in North America was described by Williams (1936) and Evans (1969), respectively.

NESTING BEHAVIOR

In this study the height of nest excavation activities for female *B. columbianus* occurred about 1300–1330 when ground temperature was approximately 27°C., after a slow beginning at about 1000 when ground temperature and wasp activity was minimal. In the nesting area the east-facing banks were the first to become active with wasps. As many as 6 hours of the daylight period were required for a female to commence and complete a nest, provisioned with her eggs and prey. "Trial digging" was observed in various places within 10 meters of the final chosen nesting site, with any incompleting burrows left open. *Belomicrus* is not known to use pre-existing animal-made holes for nesting sites (R. M. Bohart, pers. comm., 1972).

The selected site was usually on the leeward side of a sandy bank with slopes less than 30°. Soil removal commenced with the female digging rapidly, apparently with mandibles and fore legs, while assuming a 30° angle to the ground. Pellets of earth were carried between head,

¹ Presently Department of Entomology, University of California, Davis.

thorax, and the front pair of legs. The ventral posterior surface of the head bears a fringe of long hairs, termed a psammophore, which assists in holding the pellet of earth (Evans and Eberhard, 1973). The female flew obliquely backwards out of the burrow with the pellet, dumping it about 15 cm from the entrance site, from a height of about 40 cm. This movement required two seconds. No tumulus was formed around the nest as the soil was dumped at random in a semicircle around the nest entrance. Immediately after dumping the soil the wasp flew rapidly back into the burrow to repeat the action. The nest entrance measured 3–4 mm diameter when complete. During the digging process occasional short flights (of 1–3 minutes duration) away from the nest were observed, the wasp returning without prey.

One female *B. columbianus* was observed entering the incompleting burrow headfirst without prey. It plugged up the burrow entrance by grasping, apparently with its mandibles and fore legs, a 3 mm pebble located immediately outside the entrance and pulling it into the entrance, partly blocking it. Staying inside the burrow for 15 minutes, it then removed the pebble, placing it to the immediate side of the entrance. It then left the nest, head-first, and flew away without a load of earth. I assume that during the time in the nest the wasp was digging and filling deep in the ground. The lengthy amount of time was probably due to the complex of many cells being prepared (as will be described later).

Disruption of the digging process occurred if one came within about 30 cm of the nest entrance or the wasp. When disturbed the wasp flew about 2 meters away from the entrance, then returned to land within one meter of the nest, remaining there 1–2 seconds. This action was repeated 4–5 times, the female coming closer to the entrance each time. No particular orientation seemed to be chosen, i.e. the wasp did not necessarily face the source of the disturbance or the nest entrance.

Twice a species of the solitary wasp *Diploplectron* (det. R. M. Bohart) was observed entering a *B. columbianus* nest before it was completed, the duration of the stays being 2 seconds and one minute. Then *Diploplectron* left the nest carrying nothing with it. I assume it was merely resting in the nest since *Diploplectron* is not known to be parasitic or nest in pre-existing burrows (R. M. Bohart, pers. comm., 1972). Other Crabroninid and Chrysidid wasps and various sarcophagous "satellite" flies were also observed around the nesting sites but no interaction was observed between these insects and *B. columbianus*. Ants were observed to enter and quickly leave the nest entrance, without

finding prey; the presence or absence of the wasp in the nest having no apparent effect on the ant's behavior.

Immediately after completion of the nest the female would begin provisioning the nest with prey, this activity usually beginning after 1400. Upon beginning the search for prey the wasp usually plugged, partly or completely, the entrance to the nest as described previously, then would fly away, returning in 5–30 minutes with or without prey. At the wasp's return, when burdened with prey, it would rest 1–2 seconds on the ground after travelling a few meters, then recommence these short, hopping flights back to the nest. Prey were observed being carried between the middle and hind pairs of legs of the wasp, the abdomen of the prey held to the ventral side of the wasp, head forward and abdomen sometimes protruding beyond the wasp's abdomen.

Reaching the nest entrance, if it was plugged with a pebble, the wasp would place its prey at the immediate side of the entrance then remove the pebble, which was also placed near the entrance, grasp the prey with its mandibles and fore legs and enter the nest abdomen first. If the nest entrance was not plugged the wasp would fly directly into the burrow. All prey appeared to be immobilized, probably by sting. The wasp would remain in the nest from 1–25 minutes, leaving the entrance unsealed. Then it would emerge from the nest head-first, usually sealing the entrance as before, and fly away in search of further prey.

NEST ARCHITECTURE

At the study site more than 20 individual occupied nests could be found in an area of 3 meters square, and nest entrances were located as close as 2 cm to each other. In order to examine the nest architecture of *B. columbianus* 12 nests were removed from the study site in whole cores of earth, each core approximately 20 cm deep and 15 cm diameter. Removal of the cores from the dry sandy soil necessitated moistening of the core with water while carefully digging around the edge of the designated core with a hand trowel. The whole cores were placed in plastic bags to prevent collapse and loss of moisture while being transported to the Sagehen Creek Field Station, University of California (near Truckee, California) for examination.

Seven of the 12 cores examined yielded prey and wasp eggs; the other 5 contained either incompleated or empty nests. The entrance tunnel descended vertically to a depth of approximately 4.5 cm, whereupon it branched into 4–8 further tunnels (of 2 cm length) in a horizontal or slightly oblique plane, each tunnel concluding in a single cell of size 10 × 4 mm. The cells were 1.6–2.0 mm apart and arranged

in a semicircle. Tunnel diameter throughout the nest was about 3 mm. A range of 5–13 prey could be found in each cell, with 7 prey the mode.

Two undetermined species of immature Hemipterans were the only prey found in the cells, one being a Mirid bug. No prey or wasp eggs were found in the passages to the cells. All bugs were semi-paralyzed, twitching only slightly when probed. The wasp's egg was found deposited (one egg per cell) on one of the two prey found at the far end of the cell, with further bugs placed, presumably, afterwards. It is assumed the bug with the egg attached is the first (or second) bug placed into the cell by the wasp. The egg was always attached in a transverse position cephalad of the left front coxa of the bug. One egg measured 1.44×0.40 mm, the egg shell being pale white and translucent, with a pale yellow embryo visible inside.

A total of 11 wasp larvae, of different instars, were found in the examined nests, often in association with eggs in that nest; but a larva apparently remains in its cell as none were found with other larvae or eggs in the same cell. Larvae ranged in size from 2.1×0.7 mm to 3.6×1.2 mm, appearing a translucent white with green-brown viscera.

ACKNOWLEDGMENTS

I wish to express my gratitude to Dr. R. M. Bohart, University of California at Davis for identification of the wasp specimens and guidance throughout the course of the investigation. I am also grateful to Shiela M. Casey, Douglas Edwards, and Robin McMasters, all formerly of U. C. Davis, for their invaluable assistance in this project.

LITERATURE CITED

- EVANS, H. E. 1969. Notes on the nesting behavior of *Pisonopsis clypeata* and *Belomicrus forbesii* (Hymenoptera, Sphecidae). J. Kans. Entomol. Soc. 42: 117–125.
- EVANS, H. E. AND EBERHARD, M. J. W. 1973. The Wasps. David and Charles (Holdings) Ltd., Great Britain. 265 pp.
- WILLIAMS, F. X. 1936. Notes on two oxybelid wasps in San Francisco, California. Pan-Pac. Entomol. 12: 1–6.